



Birgit Grodal

Birgit Grodal died in May 2004, only 60 years old, after a long battle with cancer — a remarkable career ended long before necessary.

Between the 1960s and the 1990s, the Department of Economics at the University of Copenhagen changed from being a rather small department with mainly Scandinavian contacts and with research topics in political economics as its main interest into a large institution with world-wide contacts and with economic theory as the main research area. The focus changed from participation in the domestic debate to publishing research in highly ranked international journals. There were of course many reasons for this change connected with specific individuals and with domestic and international trends, but one of the main people behind the changes, possibly the main person, was Birgit Grodal. Throughout the entire period between the early 1970s and her death in 2004, she was either the formal head of the department, or one of the first people that the head turned to for advice. At the same time she herself became an internationally well-known mathematical economist.

Birgit Grodal was born in Copenhagen on July 24th, 1943. She started to study mathematics and physics at the University of Copenhagen in 1962, and took a master's degree in this area in 1968.

During her studies for her master's degree she followed a course in mathematical economics offered by Karl Vind, and immediately became interested in economics. Consequently, it was a natural choice for her after graduation to join the Department of Economics at the University of Copenhagen, where Karl Vind at that time was beginning to establish a research group in mathematical economics. Karl Vind (1933-2004) was already at that time a mathematical economist with an international reputation, with publications in *Econometrica* and other leading journals, but he also had a rather problematic relationship with the more established Danish professors, who were not easily convinced that his mathematical formulation of economic problems was the most fruitful line of research.

In 1968 Birgit Grodal was invited to work for a period at CORE (the Center for Operation Research and Econometrics at l'Université catholique de Louvain) in Belgium. Here she demonstrated that she was able to analyse complicated models rigorously and to obtain relevant research results, and this immediately established her position within the distinguished group of researchers affiliated with CORE who shared her interests in mathematically formulated economics in the tradition of Gerald Debreu and others. They investigated issues such as the institutions in a general equilibrium model, e.g. the mathematical specification of a market, and the relationships between optimality, market equilibrium, the core and other institutions.

In particular, Grodal became interested in attempts to formalize the concept of perfect competition by considering markets with infinitely many agents, so-called atomless economies.

Birgit Grodal's first contribution to economic research was made in the form of a gold medal dissertation entitled *En kritisk oversigt over den eksisterende teori om atomløse økonomier* (A critical overview of the present theory on atomless economies), completed in 1970. The gold medal is an old Danish system for supporting young scholars in their academic work. Being a specifically Danish honour, the gold medal is no way to get an international reputation; but in Denmark a dissertation which gains this award is considered even more highly than a very good Ph D thesis. The honour is not something which is awarded frequently. The previous gold medals awarded in economics before Birgit Grodal's in 1970 were given to Bent Hansen (later professor at Berkeley) in 1944 and Hans Brems (later professor in Illinois) in 1942. An indication of the tradition among Danish economists at that time is that Birgit Grodal's contribution in an area which only a handful of Danes could understand was nevertheless written in Danish. This would now be unthinkable, thanks in large measure to Birgit Grodal herself.

The research results also found their way into the international literature in the form of articles in *Econometrica* and an important contribution to the *Journal of Mathematical Economics*. The latter can be viewed as the final formalisation of the idea that atomless economies should be considered as approximations for more real economies with a large but finite number of agents. Since any real economy must have a finite number of agents, this result is a prerequisite for the relevance of the atomless model.

In 1972 Birgit Grodal became an associate professor. Five years later, at the age of 34, she was made a full professor at the University of Copenhagen, and she held this position until her death on May 4th, 2004.

But even though Birgit's base was the University of Copenhagen, she had many international contacts, co-authors and friends. A considerable number of her works were written together with authors from all over the world. She was guest professor for shorter or longer periods at CORE, and also at the University of California at Berkeley, the University of Bonn and many other places, and she was an ever helpful host for countless visitors to Copenhagen.

Birgit Grodal was not one of those economists who take an active part in political debate. She was not known to Danish politicians or the Danish public. She wrote very little that was comprehensible to anyone other than theoretical economists. Her ideal of scientific exactness would have been

difficult to combine with articles in newspapers or in popular journals. The economic policy debate, with its mixture of dubious interpretations of elements of economic science, questionably-used statistics and political attitudes, was far from Birgit Grodal's ideals. All her major papers were published in highly technical economic journals such as *Econometrica*, the *Journal of Mathematical Economics*, the *Review of Economic Studies*, and the *Journal of Economic Theory*.

Her contributions were formularisations and generalisations of economic ideas and intuitive statements put forward by others. In several cases this revealed that intuitive deductions from simple partial models did not hold generally. For models with imperfect competition, she (with Egbert and Hildegard Dierker) found that equilibria will often not exist, and they also found that the predictions of firm behaviour and thereby the whole theory are dependent on the choice of a 'price normalization rule', which was previously believed to be unimportant. For models where markets are not complete in that there are commodities that cannot be traded, they demonstrated in an article in *Econometrica* in 2002 that the equilibrium outcomes will often not be as efficient as suggested by intuition and earlier results. Together with Jean-Francois Mertens, she generalised to continuous time a characterisation of preferences for consumption streams suggested for discrete time by Tjalling C Koopmanns. With Werner Hildenbrand she investigated how to obtain properties of aggregate demand from assumptions on the distribution of income among consumers. Her last research project was to extend general equilibrium models to include club membership as commodities, following a suggestion made by James M Buchanan in 1965. This was a demanding task, since club memberships are indivisible and agents' preferences for being members of a specific club depend upon who else belongs to the club. Together with three colleagues from California (Bryan Ellickson, Suzanne Scotchmer and Bill Zame) she managed to solve all the technical problems involved, providing a general characterisation of equilibria with many agents in economies with clubs.

While she was unknown in Denmark, she was one of the very first Danish economists to become internationally famous, both through the results of her research and through her services to the international community of researchers in economics. She became a Fellow of the Econometric Society in 1981, and a member of that society's council from 1987 to 1989 and from 1992 to 2004. She was associate editor of the *Journal of Mathematical Economics* from 1972 to 1985 and of *Econometrica* from 1982 to 1985. She was very active in the European Economic Association, where she was on the council, with very short interruptions, from 1987 to 2000. She was elected vice-president in 2002 and would have been president in 2005 if she had not died before taking office. She was a member of the Academia Europaea from 1998 onwards.

Thus she was not a theorist of the impractical type. From the early 1970s onwards she held a considerable number of positions in research councils and committees. She was

among the young teachers who took over power in the Danish university system when the students broke the dominance of the old professors in the years after 1968, and in the whole period from the mid-1970s to her death she was one of the most powerful members of the Social Sciences faculty at the University of Copenhagen. She was Dean of Social Sciences 1977-80, Chairman of the Department of Economics 1982-84 and a member of the Danish Social Science Research Council 1982-91.

One of her main interests, and an area in which she focussed a lot of her energy, was the education of young scholars. She was an enthusiastic advisor for many master's and Ph D degree students, and her Ph D students in particular were very close to her heart. She was head of the Doctoral Program in Economics for the Scandinavian Countries 1992-1997, and was for many years involved in the European econometric winter meetings for young economists.

Even if she was a distinctly theoretical economist, she did not avoid more practical jobs completely; for the last year of her life she was a member of the Danish Competition Council and of the board of one of the largest Danish lending institutions.

Birgit Grodal will be remembered as an uncompromising supporter of high academic standards and exactness in economic argumentation; she was until her much too early death an energetic fighter for these views.

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